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(54) Title: LARGE-SIZED, MOUNTABLE AND REMOVABLE SHEET ASSEMBLY AND METHOD THEREFOR

(57) Abstract: A large-sized sheet assembly for receiving graphics and/or text from a printer includes a paper facestock, an adhesive film and a release liner. The adhesive film extends over an entire side of the facestock. The release liner covers the adhesive film and may be scored or otherwise provided with lines of weakness such that the release liner may be removed in individual sections. A method of printing and using the large-sized assembly includes printing the assembly with a wide-format printer, such as a wide-format inkjet printer, removing a section of the scored release liner and adhering a section of the sheet assembly to a substrate. Additional sections of the release liner are removed and corresponding portions of the sheet assembly are sequentially adhered to the substrate. The substrate may be a wall, a glass window, or any of a variety of different surfaces.

LARGE-SIZED, MOUNTABLE AND REMOVABLE SHEET ASSEMBLY AND METHOD THEREFOR

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/197,976, which was filed on April 17, 2000, and U.S. Provisional Patent Application Serial No. 60/246,133, which was filed on November 6, 2000.

BACKGROUND

FIELD OF THE INVENTION

The present invention relates to large-sized printed sheets that are to be temporarily adhered to a substrate and to a method of printing and mounting such sheets.

PRIOR ART

Large-sized, custom printed sheets are used in a wide range of applications, including advertising. Digital printers, including digital offset and wide-format inkjet printers, allow end-users to custom-print large-sized graphics onto sheets "on demand." After printing, users can apply a printed large-sized sheet to a wall or window and then remove the sheet within a relatively short period of time, typically from about one day to 3 months.

US Patent No. 5,972,155, issued to Coopridner et al., discloses a repositionable signage sheet with a pattern-coated removable pressure-sensitive adhesive. The sheet does not lay flat on substrates because the adhesive is coated in a pattern. That is, the sheet does not adhere well to the substrate in areas of the sheet where there is no adhesive.

US Patent No. 5,749,994, issued to Sundet, describes a laminate for application of graphics to a substrate, and particularly to a glass substrate. The cover sheet of the laminate is a vented transparent polymeric sheet that bears a layer of vented removable pressure-sensitive adhesive.

US Patent No. 4,985,302, issued to Sala, discloses a removable self-adhesive sheet with a writable surface as well as an ink formulation for such a writable surface.

The adhesive composition disclosed is a mixture selected from the water-dispersion acrylic resins, self-crosslinking solution acrylic resins, synthetic rubbers, etc.

US Patent No. 4,822,670, issued to Ono et al., describes a removable adhesive sheet or tape which contains a film or paper sheet with a removable adhesive. The removable adhesive is a copolymer comprising an acrylic ester or a methacrylic ester as a main component, and adhesive fine particles that have a particle size ranging between 1 and 150 microns. The patent does not mention an ink-jet printable application or printing on large-size sheets.

US Patent No. 5,670,226, issued to Yoshizawa, describes a removable adhesive sheet. The sheet includes a release liner, an adhesive layer and a surface stock as laminated. The removable adhesive claimed is made by emulsion polymerization.

US Patent No. 5,571,617, issued to Coopridge et al., describes a sheet material containing polymer microsphere removable adhesive. No application of such sheet material is indicated.

US Patent No. 5,290,067, issued to Langen, describes a printable sheet material that is used for the window sticker application. The removable adhesive is pattern coated to make the sticker removable.

US Patent No. 5,128,412, issued to Miyasaka, et. al., discloses a removable adhesive having elastomeric micro-balls and water-soluble ionic monomer. The adhesive composition is from emulsion or solution polymerization.

US Patent No. 5,407,718, issued to Popat et al., discloses labels made from a transparent paper. The transparent paper is coated with an inkjet ink receptive coating. The patent does not disclose using an ultra-removable adhesive, nor does it disclose applying an inkjet ink receptive coating to a large-sized sheet.

Minnesota Manufacturing and Mining (3M) recently introduced a product under the trade name 3M Inkjet Poster Paper 8581. The sheets are backed with two-inch wide strips of removable adhesive applied at regularly spaced intervals. Because the adhesive is applied only in strips on the back, the portions of the sheet that do not include adhesive do not adhere to the substrate. The facestock therefore does not uniformly adhere to the substrate.

SUMMARY OF THE INVENTION

According to one particular embodiment of the invention, a repositionable sheet assembly for receiving printed images has a printable facestock sheet having a printable

side and an adhesive-bearing side. An ink-receptive coating is on the printable side and an adhesive layer is on the adhesive-bearing side. The adhesive layer is an ultra-removable, pressure-sensitive adhesive, and the adhesive layer extends over the entire adhesive-bearing side. The adhesive layer has a peel adhesion that is less than about 3.0 Newtons/inch. A release liner sheet covers the adhesive layer, with the adhesive layer being in between the release liner and the facestock sheet. The release liner sheet is divided by lines of weakness into immediately-adjacent sections, with the release liner sections being removable from the assembly independently of one another. The facestock is coated on the adhesive-bearing side with a primer to anchor the adhesive to the facestock.

The embodiment may have other features. The release liner may be provided with parallel lines of weakness extending across a dimension of the release liner, with the lines of weakness being spaced at regular intervals from one another. Alternatively, the lines of weakness may be spaced at irregular intervals from one another. The release liner may be provided with diagonal lines of weakness. By way of example, but not limitation, the primer may have a coat weight of 0.5 to 3 gsm, or between 1 to 1.5 gsm.

According to another particular embodiment, a large-size, repositionable sheet assembly for receiving printed images may include a printable facestock sheet that has a printable side and adhesive-bearing side. The ink-receptive coating may be on the printable side and an adhesive layer may be on the adhesive-bearing side. The adhesive layer may be an ultra-removable, pressure-sensitive adhesive, with the adhesive layer extending over the entire adhesive-bearing side. A release liner may cover the adhesive layer, with the adhesive layer being in between the release liner and the facestock sheet. The release liner may be divided into sections by lines of weakness, with the release liner sections being removable independently of one another.

In particular embodiments, the large-sized sheets may be at least approximately 24 or 36 inches wide. The adhesive may comprises microspheres. The adhesive film may have a peel adhesion that is between 1.2 and 2.6 Newtons/inch, or that is less than about 3.0 Newtons/inch. The adhesive film may also comprise more than one layer.

A method of printing a large-size repositionable sheet assembly and applying the printed sheet assembly to a substrate may include printing onto the printing side of the assembly with a wide-format inkjet printer. A first portion of the release layer is removed

along a line of weakness. The first portion of the sheet is then adhered to a substrate. A second portion of the release layer is then removed along another line of weakness, and a second portion of the sheet is then adhered to the substrate. In one particular application, the sheet assembly is applied to the substrate for a period of time ranging from about one day to about three months.

Various other aspects of the invention will become apparent from the Detailed Description of a Preferred Embodiment, the drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view of a large-size sheet assembly according to one embodiment of the present invention;

Fig. 2 is a rear view of the large-size sheet assembly of Fig. 1;

Fig. 3 is a cross-sectional view taken about Section 3-3 of Fig. 1;

Fig. 4 is a rear view of an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

One objective of the present invention is to provide paper media with ultra-removable pressure-sensitive adhesives for use primarily in digital printing equipment. An "ultra-removable" adhesive typically has a peel adhesion that is less than about 3.0 Newtons/inch. This low peel adhesion can be achieved through the selection of the adhesive, the coat weight, the drying/processing conditions, and/or other factors.

The printed piece will typically be applied to a wall, a window or other substrate, and then will be removed within a few weeks or months. Wall board, painted wall board, wallpaper, glass, painted steel, wood, painted cinder blocks, and fabric-covered walls are specific non-limiting examples of substrates to which the printed piece may be applied. A few of the many possible applications include banners or posters for conferences and meetings, as well as posters for advertising purposes.

Referring to the drawings, one embodiment of a large-sized sheet according to the present invention includes a paper facestock sheet 10. The sheet has a printable side 12 that includes an inkjet ink receptive coating 14 to receive and retain ink from an inkjet printer. In other embodiments, coatings other than inkjet ink receptive coatings can be used, to adapt the sheet to receive printing from other types of printers.

The facestock sheet 10 also has an adhesive-bearing side 16, which includes a layer of primer 18. A suitable facestock having an inkjet ink receptive coating and a

primer can be obtained commercially. One example of a suitable facestock sheet is 80# Presentation Matte, which is available from P.H. Glatfelter Inc. of York, Pennsylvania, although other papers can be used. The 80# Presentation Matte paper comes pre-coated with an inkjet ink receptive coating and a primer.

One suitable primer is described as follows.

<u>Component</u>	<u>Weight (lbs.)</u>
Water	682.6
PVA	30.0
Defoamer	1.0
Silicate	70.0
Biocide	1.0
Total Weight	784.6

The following are examples of suitable commercial products that may be used in forming the primer embodiment described above. One suitable PolyVinyl Alcohol (PVA) is available commercially as Elvanol 71-30 from E.I. du Pont de Nemours and Company. A suitable defoamer is available as Drewplus L-139 from Drew Industrial Division of Ashland Specialty Chemical Company. One suitable silicate is available as Zeolex 7 from Huber Chemicals Corporation. One suitable biocide is available commercially as Tektamer 38.

One embodiment of a suitable primer is prepared as follows. The water is added to a mixing vessel at a temperature of 24°C (75°F) or below. An agitator is then started. The defoamer is added to the vessel and mixed. The PVA is added into the vortex so that it is rapidly wet out and dispersed. The slurry is stirred for approximately 10 minutes. The temperature of the mix is raised to 90°C (194°F), and the mix continues to be stirred until the PVA is dissolved.

Once the PVA is dissolved, the PVA solution is cooled. The silicate is added to the vortex so that it is rapidly wet out and dispersed. The mixture is agitated for approximately 15 minutes. The biocide is added and is mixed for 5 minutes.

This particular embodiment of a primer may have a percentage of solids of 12% - 14%, and a viscosity of 60 cps (LVT, #3 @ 12 rpm). It should be understood that the foregoing is merely an example of a suitable primer, and that other primers may be used.

A wide variety of facestocks may be used in addition to paper-based facestock. Plastic facestocks may be used, with or without a print-receptive top coating. Various types of films may be used for the facestock, including transparent, translucent, and

opaque films. The films may be cast or extruded. Cardstocks, fabrics and foils may also be used. A particularly desirable facestock is vinyl, such as cast or calendared vinyl films, which are available commercially from many different vendors. Indeed, a plethora of different facestocks are in use in the label art; for instance, and those skilled in the art of the present invention will recognize that a great many potential types of facestock may be used in the present invention.

A continuous film of adhesive 20 covers the entire adhesive-bearing side 16 of the facestock. The adhesive film 20 includes ultra-removable ("UR") microspheres, which are known in the adhesive art to be a component of typical repositionable adhesives. In particular, the adhesive is a suspension polymer microsphere removable adhesive. Suitable adhesives are described in US Patent No. 5,656,705, which Avery Dennison Corporation owns. Other suitable adhesives are available commercially. For example, one suitable water-based microsphere adhesive is sold by National Starch and Chemical Company under the tradename Micro-Lok™. The adhesive film 20 may have a coat weight of less than 20 gsm (grams of coating per square meter), and preferably between about 10-18 gsm. In one specific example, an adhesive coat weight of 17 gsm was found to perform well on a variety of surfaces. The adhesive film is applied so that it has a peel adhesion that is typically between 1.2 and 2.6 Newtons/inch, or at least less than about 3.0 Newtons/inch. The preferred range of primer coat weight is 0.5 to 3 gsm, with the most preferred primer coat weight being 1 to 1.5 gsm. The preferable range of coat weights of the adhesive and the primer may vary depending on the facestock that is used in a particular embodiment.

It should be noted that suitable microsphere-based adhesives may be applied directly to the facestock, without a primer. Alternatively, priming may be used to improve anchorage to the facestock and to minimize transfer of microspheres to the facestock. Additional primers that may be used are disclosed in US Patent No. 5,656,705, which Avery Dennison Corporation owns. Techniques for applying an adhesive to a facestock are well known in the art. One approach is to coat the adhesive on the release liner. The adhesive then transfers to the primed facestock when the facestock is brought into contact with the release liner. Another approach is to coat the adhesive directly onto the facestock.

As another alternative, the adhesive may be applied in more than one layer. For example, U.S. Patent Nos. 5,993,961, 5,925,432, 5,827,609 and 5,558,913, which are incorporated by reference, all describe multi-layer adhesive arrangements. In the

arrangement of U.S. Patent No. 5,993,961, a first layer of adhesive is applied to the facestock, and a second layer of adhesive is applied to the first layer. The purpose of the first layer is to act as a "barrier" that prevents oils, resins, tackifiers or plasticizers from migrating from the second layer to the facestock.

Various other multi-layered adhesive structures can be imagined. For example, U.S. Patent No. 5,827,609, issued to Ercillo, et. al., discloses a multi-layered adhesive construction having layers of adhesive with different glass transition temperatures. The multi-layered construction shows good adhesion to a wide variety of substrates, and typically converts well. U.S. Patent No. 5,558,913, issued to Sasaki, et. al., discloses a multi-layered adhesive construction in which a permanent pressure sensitive adhesive is applied to the facestock, and a removable pressure sensitive adhesive is applied to the permanent pressure sensitive adhesive.

Methods for applying multiple layers of adhesive are described in U.S. Patent Nos. 5,728,430, 5,925,432, and 5,962,075. The multiple layers may be applied to the facestock simultaneously using methods known in the art.

Considering further an embodiment of the present invention, a release liner 22 covers substantially all of the adhesive film. The release liner includes a silicone coating. In a presently preferred embodiment, the release liner is a 40# layflat liner that is 2.8 mils thick. Other suitable release liners include silicone coated films or polycoated kraft, as are known in the art. Suitable pre-siliconized release liners are available commercially. The release liner may be pre-printed with indicia and/or graphics, such as the name and logo of the manufacturer.

In a presently preferred embodiment, the release liner 22 is mechanically scored. Suitable methods of scoring the release liner are disclosed in US Patent Nos. 4,537,809 and 4,356,375, which Avery Dennison Corporation owns. The release liner is scored so that the end-user can remove the release liner in individual sections. This allows the end-user to mount the printed large-size sheet in a section-by-section fashion, which is particularly convenient for mounting large-size sheets. In one embodiment of the invention that Fig. 2 illustrates, the score lines 24 extend vertically down the release liner. The score lines are spaced approximately 1 inch apart, so that the end-user may remove the release liner in one-inch strips and mount the large-sized sheet in one-inch segments. Numerous other scoring patterns are suitable, such as the diagonal pattern that Fig. 4 illustrates, in which score lines 24' extend diagonally along the back of the release liner. Fig. 4 illustrates one section of the release liner 26 partially removed,

such that a portion of the adhesive layer 20 is exposed. The score lines may alternatively be spaced in an irregular or non-uniform pattern, as well.

It should be noted that the present invention encompasses embodiments in which the liner is not scored, but is provided as a continuous sheet. Furthermore, as alternatives to scoring, the liner may be cut, slit, perforated, or otherwise provided with lines of weakness along which segments of the liner may be removed.

The release liner and/or facestock may be remoisturized to prevent channeling during use. "Channeling" refers to a tendency of a sheet to wrinkle when it absorbs water from the atmosphere. A sheet will absorb less water from the atmosphere if the sheet is "remoisturized" to increase the level of moisture in the sheet. To remoisturize the liner and/or facestock, the assembly can be subjected to a steam treatment or another method known in the art. The presently preferred final moisture content of the facestock is between about 3.5% to 5.5% moisture by weight. The presently preferred final moisture content of the release liner is between about 4.5% to 7.0% moisture by weight. When non-paper facestocks and/or release liners are used, such as cast or calendared vinyl for the facestock, the moisture content of the facestock is less of an issue.

An end-user may print and mount the sheet according to the following method. The end-user employs design software to create a desired layout consisting of graphics and/or text. The software controls a wide-format printer, such as a large-format inkjet printer. At the command of the user, the software causes the wide-format printer to print the graphics and/or text onto the printable surface of a large-sized sheet assembly as described above. The user removes the printed assembly from the printer, and removes one or more sections of the pre-scored release liner. The user then adheres a first portion of the sheet to a substrate, such as a wall or window. The user continues to sequentially remove sections of the release liner and mount the sheet to the substrate in a section-by-section manner until the sheet is completely mounted to the substrate.

Considering the process of using a computer to design and print the large-sized sheet assembly, Avery Dennison owns US Patent No. 5,892,892, incorporated by reference herein, entitled "Computer-Printable Adhesive Note System," which describes a method of designing graphics and/or text to be printed onto small-sized postable notes. The method of that patent can be adapted to design and print the large-sized assemblies that are described above. In broad terms, the method works in conjunction with a computer and software for formatting and causing a wide-format inkjet printer to

print onto a large-size sheet. The software would be provided on a storage medium readable by the drive of the computer; and (2) a plurality of instructions stored on the storage medium and including instructions for: (a) configuring the computer to display on the monitor a plurality of sheet-printing variables associated with the large-size assembly; (b) configuring the computer to enable the sheet-printing variables to be selected via the input device; (c) configuring the computer to receive information, via the input device, to be printed on the large-size assembly; and (d) configuring the computer and/or the printer to print the received information on the large-size sheet assembly in accordance with the selected large-size sheet printing variables.

Considering now additional details of specific embodiments of the present inventions, many wide-format inkjet printers are adapted to print sheets having widths of 36 or 49 inches. Consequently, it is presently preferable for the sheet assembly to have a width of 36 or 49 inches, although the specific widths will be a function of the sheet widths that the printer will accept. For example, an assembly that is approximately 24 inches wide may be provided for digital offset, Indigo, Xiekon and other digital print technologies. The assembly may be fed to the printer in the form of a continuous-feed roll, or it can be pre-cut into individual sheets.

The printed assembly can be applied to a broad range of substrates. The most common substrates are likely to be walls and windows, although other substrates are possible. Wall board, painted wall board, wallpaper, glass, painted steel, wood, painted cinder blocks, and fabric-covered walls are specific examples of substrates to which the assembly may be applied. For some surfaces, such as smooth, vinyl wallpaper, the adhesive coat weight on the sheet can be increased slightly to improve adhesion.

As mentioned above, constructions according to the present invention may be used in a wide variety of applications. Specific examples include printed sheets that are used as window graphics, back-lit signage, and sheets that are temporarily adhered to a surface such as a wall and that act as temporary "whiteboards" on which a user may write. Other examples include temporary advertising or signage, such as point of purchase advertising, billboards, banners, and temporary wall paper. The present invention may also extend to protective barriers, such as seat covers. Numerous other applications can be readily imagined, and the present invention is not limited to a particular application.

The foregoing has described a presently preferred embodiment of the invention. However, the invention is not limited to a specific example that is described in the

specification or that is illustrated in the drawings. Various modifications of the assembly are possible within the scope of the invention. For instance, the specific adhesive that is used for the adhesive film 20 may be modified. Adhesives having a higher peel force but which are still removable may be used in place of the ultra-removable adhesive described above. A dual or multi-layered adhesive may be used instead of, or in addition to, the primer 18 on the facestock. The layers may be applied sequentially, concurrently or substantially concurrently, in accordance with methods known in the art.

The specific facestock that is described above may be modified. The facestock may be made of polyester, other papers, or vinyls, for example. A particularly durable facestock may be employed for outdoor use. These various facestock materials would be coated with an inkjet ink receptive coating (or, if another type of printer is to be used, an appropriate print-receptive coating). Different adhesives will be suitable for use with the various different types of facestocks. The specific thickness of the facestock and the release liner can be varied. For example, if the assembly is to be provided in the form of a roll, the facestock and the release liner may be made particularly thin to minimize the weight and thickness of the roll and/or to reduce the tendency of the roll to unwrap itself. The release liner may also be provided without lines of weakness, for use in applications where it is not necessary to sequentially remove portions of the liner while mounting the printed sheet on the substrate.

These and various other modifications may be made within the scope of the invention, which is defined by the following claims.

Claims

What is claimed is:

1. A repositionable sheet assembly for receiving printed images comprising:
a printable facestock sheet having a printable side and an adhesive-bearing side, with an ink-receptive coating on said printable side and an adhesive layer on said adhesive-bearing side;
said adhesive layer being an ultra-removable, pressure-sensitive adhesive, said adhesive layer extending over the entire adhesive-bearing side, wherein the adhesive layer has a peel adhesion that is less than about 3.0 Newtons/inch; and
a release liner sheet covering said adhesive layer, with said adhesive layer being in between said release liner and said facestock sheet;
said release liner sheet being divided by lines of weakness into immediately-adjacent sections, said release liner sections being removable from said assembly independently of one another;
said facestock being coated on said adhesive-bearing side with a primer to anchor said adhesive to said facestock.
2. A repositionable sheet assembly as defined in claim 1, wherein said release liner is provided with parallel lines of weakness extending across a dimension of said release liner, said lines of weakness being spaced at regular intervals from one another.
3. A repositionable sheet assembly as defined in claim 1, wherein said release liner is provided with parallel lines of weakness extending across a dimension of said release liner, said lines of weakness being spaced at irregular intervals from one another.
4. A repositionable sheet assembly as defined in claim 1, wherein said release liner is provided with diagonal lines of weakness.
5. A repositionable sheet assembly as defined in claim 1, wherein said primer has a coat weight of 0.5 to 3 gsm.
6. A repositionable sheet assembly as defined in claim 1, wherein said primer has a coat weight of 1 to 1.5 gsm.
7. A large-size, repositionable sheet assembly for receiving printed images comprising:

a printable facestock sheet having a printable side and adhesive-bearing side, with an ink-receptive coating on said printable side and an adhesive layer on said adhesive-bearing side;

said adhesive layer being an ultra-removable, pressure-sensitive adhesive, said adhesive layer extending over the entire adhesive-bearing side; and

a release liner covering said adhesive layer, with said adhesive layer being in between said release liner and said facestock sheet;

said release liner being divided into sections by lines of weakness, said release liner sections being removable independently of one another.

8. A large-size, repositionable sheet assembly as defined in claim 7, wherein said facestock is coated on said adhesive-bearing side with a primer.

9. A large-size, repositionable sheet assembly as defined in claim 8, wherein said primer has a coat weight of 0.5 to 3 gsm.

10. A large-size, repositionable sheet assembly as defined in claim 8, wherein said primer has a coat weight of 1 to 1.5 gsm.

11. A large-size, repositionable sheet assembly as defined in claim 7, wherein said sheet assembly is at least approximately 36 inches wide.

12. A large-size, repositionable sheet assembly as defined in claim 7, wherein said sheet assembly is at least approximately 24 inches wide. 13. A large-size, repositionable sheet assembly as defined in claim 7, wherein said adhesive comprises microspheres.

14. A large-size, repositionable sheet assembly as defined in claim 7, wherein said release liner is divided by parallel lines of weakness extending the length of said release liner, said lines of weakness being spaced at regular intervals from one another.

15. A large-size, repositionable sheet assembly as defined in claim 7, wherein said release liner is divided by parallel lines of weakness extending the length of said release liner, said lines of weakness being spaced at irregular intervals from one another.

16. A large-size, repositionable sheet assembly as defined in claim 7, wherein said release liner is divided by diagonal lines of weakness.

17. A large-size, repositionable sheet assembly as defined in claim 7, wherein the adhesive film has a peel adhesion that is between 1.2 and 2.6 Newtons/inch.

18. A large-size, repositionable sheet assembly as defined in claim 7, wherein the adhesive film has a peel adhesion that is less than about 3.0 Newtons/inch.

19. A large-size, repositionable sheet assembly as defined in claim 7, wherein the adhesive film comprises more than one layer.

20. A method of printing a large-size repositionable sheet assembly and applying the printed sheet assembly to a substrate, comprising the steps of:

preparing a printable facestock sheet having a printable side and an adhesive-bearing side; with an ink-receptive coating on said printable side and an adhesive layer on said adhesive-bearing side, said adhesive layer being an ultra-removable, pressure-sensitive adhesive, said adhesive layer extending over the entire adhesive-bearing side, and a release liner on said adhesive layer, with said adhesive layer being in between said release liner and said facestock sheet, said release liner extending over the entire adhesive layer, said release liner being divided by lines of weakness into sections, said release liner sections being removable independently of one another;

printing onto the printing side of the assembly with a wide-format inkjet printer;

removing a first portion of said release layer along a line of weakness;

adhering a first portion of said sheet to a substrate;

removing a second portion of said release layer along another line of weakness; and

adhering a second portion of said sheet to the substrate.

21. A method of printing a large-size repositionable sheet assembly and applying the printed sheet assembly to a substrate as defined in claim 20, wherein the sheet assembly is applied to the substrate for a period of time ranging from about one day to about three months.

